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SOME REFLECTIONS ON THE MASTITIS PROBLEM*

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Despite 20 years of active research and investigation, mastitis continues to be a problem of concern to the dairy industry in every country where the dairy cow is an important factor in agriculture. Does this mean that research has failed to find a solution to the problem? The recent death of F. C. Minett has made one reflect on the history of mastitis research in this country. Minett was a true pioneer in this field; and if we think of the state of knowledge in the late 1920's, when he commenced work on mastitis, and what we know to-day, we realise that we have learned a great deal.

For many years it had been realised that mastitis was associated with the presence of bacteria in the udder, but the bacteriology of the condition was extremely confused. In this country Minett, with his junior colleagues, Stableforth and S. J. Edwards, on the Continent Seeleman and Diernhofer, and in the U.S.A. Jones, Little and Plastridge, in a series of careful studies gradually produced a coherent bacteriological picture. In this work, Minett was outstanding. Definitions of the three streptococcal species, *Str. agalactiae*, *Str. dysgalactiae* and *Str. uberis*, and the pathogenic staphylococci associated with mastitis were essential first steps in the study of the disease. Until these were achieved even clinical definitions were of little use, and certainly the conception of mastitis as one disease was bound to continue. In fact the tendency to discuss mastitis as one condition still continues, and although in strictly pathological terms there may be some reasons for this, on bacteriological and epizootiological grounds there can be no justification for this approach. Studies of control and treatment all point to the fact that the various mastites need separate consideration, although one recognises that certain common factors may operate in all types of mastitis. Proceeding on this essential basis of adequate bacteriological diagnosis research has added to our knowledge of epizootiology, and from that to control both by hygiene and treatment, so the last 20 years have not been wasted; but much remains to be done. What is the position to-day?

GENERAL INCIDENCE

It is surprising how few reliable figures we have to indicate the economic importance of many of our major animal diseases, and mastitis is no exception.

In 1941 the then N.V.M.A. provided figures for losses due to mastitis. It was stated that 25 per cent. of the total cow population of 3,200,000 were infected, and that these 800,000 cows would lose 12 per cent. of their milk (60 gallons out of the average lactation of 500 gallons.) Presumably these calculations were based on the assumption that these infected cows, if not already clinical cases, would become so before the year was out. This assumption is of some importance because it is related to the method of assessing incidence, which can be done by one of two methods. The first is to sample bacteriologically a representative number of herds and label all bacteriologically positive cows as potential sufferers from mastitis. The second method is to examine herds for cases of clinical mastitis. The first method tends to over-emphasise the losses, because not all bacteriologically positive cows at any one test will necessarily suffer economic damage from the organism isolated at the test in question. The second method of survey may also over-emphasise losses if the herds examined are mastitis problem herds. In an attempt to overcome some of these difficulties we have been conducting a bacteriological examination of *every* case of mastitis seen *prior to treatment* in one veterinary practice. (I am deeply grateful to Mr. E. Wilkinson, M.R.C.V.S., and his colleagues of Derby, for their co-operation.) This survey has been in progress for five years. The method of survey rules out the risks of case selection by the veterinary surgeon, the usual fallacy of clinical surveys, but of course it cannot avoid selection by the farmer. Some of our figures may be of interest.

In 1951 the veterinary surgeons concerned made a census of the cow population in their practice. The total cow population was 4,267 animals. In that year there were 578 cases of mastitis which gives an incidence of clinical mastitis of 13·5 per cent. The average cow population of the practice over the period 1950-52 was probably 4,000 cows, and the average number of clinical cases of mastitis was 584, an incidence of 14·6 per cent., so that in our area we can say that the incidence of clinical mastitis is about 14 per cent.

(Incidentally a considerable amount of information on a large number of diseases could be obtained by a similar approach. All that would be involved is a cow census of the practice, relatively easily done by noting the number of cows owned by each client on the books, and keeping a record in the daybook of every case seen of the condition to be surveyed. If enough representative veterinary practices could be persuaded to do this on an agreed plan the B.V.A. could collect figures of great value on a national scale, as such figures do not exist for unscheduled diseases).

INCIDENCE OF *Str. Agalactiae* AND OTHER ORGANISMS

How is this total figure made up, or in other words what bacteria contribute to this total?

I have presented some of the figures in Table I to the Aberdeen Congress (Hughes, 1953) but I give them again as relevant to my theme, with the addition of this year's results. (See Table overleaf.)

These figures total 2,684 cases in 1949-53, a figure from which we can draw some conclusions. Over the five years *Str. agalactiae* has totalled 689, an incidence of 25·3 per cent., and by far the most important cause of mastitis.

* Paper given to the Sussex Veterinary Society on February 5th, 1954.

TABLE I
A BACTERIOLOGICAL SURVEY OF CLINICAL MASTITIS, 1949–53

	Str. agalactiae	*Str. dysgalactiae*	*Str. uberis*	*Staph. pyogenes*	*C. pyogenes*	Other organisms	"Negatives"	Contaminated samples	Total cases
1949 ...	180	65	116	68	47	79	49	21	625
Per cent. ...	28·8	10·4	18·56	10·88	7·52	12·64	7·84	3·36	
1950 ...	207	62	106	76	32	108	42	21	654
Per cent. ...	31·64	9·47	16·21	11·63	4·91	16·51	6·42	3·21	
1951 ...	126	65	115	81	54	72	26	39	578
Per cent. ...	21·82	11·84	19·87	14·01	9·34	12·45	4·52	6·75	
1952 ...	113	82	91	61	61	54	19	38	519
Per cent. ...	21·77	15·80	17·54	11·75	11·75	10·40	3·66	7·32	
1953	63	28	56	51	17	47	10	36	308
Per cent. ...	20·41	9·10	18·20	16·58	5·51	15·27	3·24	11·70	
Totals ...	689	302	484	337	211	360	146	155	2,684
Per cent. ...	25·3	12·07	18·10	12·55	7·80	13·40	5·40	5·50	

Even if we consider this species year by year, *Str. agalactiae* is the biggest single item in the total each year, although there is some suggestion that its incidence is declining slowly from 28·8 per cent. in 1949 to 20·4 per cent. in 1953. The next most important organism is *Str. uberis* with an average percentage for the four years of 18·10 per cent., a figure which shows little change in each of the four years.

Do these results reflect conditions in other parts of the country? The question is not easily answered for to the best of my knowledge results of similar surveys of every clinical case prior to treatment have not been published. The closest comparison we have is with figures from Weybridge, presented by Stableforth (1953). In 1952, 2,005 mastitis samples were examined, 18 per cent. were due to *Staph. pyogenes*, 12 per cent. to *Str. uberis*, 9 per cent. to *Str. agalactiae* and 8 per cent. to *Str. dysgalactiae*. However, 27 per cent. were bacteriologically negative which should be compared with our 5·4 per cent. for the five years. It was suggested that the high figure in the Weybridge results was due to treatment prior to sampling. If this is so it is clear on this criterion alone that the two surveys are not strictly comparable as our samples were taken prior to treatment.

Employing the first method of survey by herd sampling, we found in the N.E. Midlands in 1946-48 in 19 herds with a total cow population of 591 animals, that 91 harboured *Str. agalactiae* and 120 were excreting *Staph. pyogenes*, percentages of 15·2 per cent. and 20·3 per cent. respectively, Hughes (1948). The figure of 15·2 per cent. for *Str. agalactiae* corresponds closely to that obtained in the counties of Surrey and Herts, given by Wilson (1952) following the examination of 6,928 cows.

All these figures are confusing, but the following deductions may be permissible. Herd surveys will give one a picture of the bacteriological risks to the udder prevalent in an area, and bacteriological examination of all clinical cases will tell one what is actually responsible for udder damage; but the resulting picture will vary from area to area. In districts where the majority of dairy herds are self contained and well managed, the herd incidence of *Str. agalactiae* will continue to decline, and also the number of clinical cases due to it, until it is a relatively infrequent cause of mastitis. In areas where commercial milk production in flying herds is the predominant activity, *Str. agalactiae* will still be a feature of herd bacteriology and it will account for a substantial proportion of the clinical cases.

This difference is a reflection of the success of penicillin treatment applied intelligently in self-contained herds. In such herds the now well known "blitz" treatment is capable of completely eradicating *Str. agalactiae* infection, and it results in substantial improvements in herd milk yields. Wilson (1953) has stated that the average yield increased by 70 gallons in 25 herds containing over 1,000 cows. These advantages should not be forgotten when we hear the jeremiads about the increasing incidence of other infections not so responsive to treatment. Staphylococcal and other infections may be more prevalent in these cleared herds, but we still await satisfactory evidence that this is so. In the meantime these herds are producing more milk than previously.

FACTORS INFLUENCING THE INITIATION OF INFECTION

Murphy (1945) has stylised the genesis of mastitis in three stages as "invasion," "infection," and "inflammation." The choice of these words is somewhat unfortunate but the meaning attached to them appears to be as follows. "Invasion" is defined as transportation of bacteria to the teat and passage up the teat canal to the interior of the udder cavities. "Infection" is the presence of organisms in the udder without penetration of the mammary tissues, and "inflammation" is the stage when organisms are sufficiently well established in the udder tissues to give rise to pathological alterations. These stages may seem at first sight to be somewhat academic, but they can be related to practical steps designed to avoid or reduce the results of mastitis. Our control measures must be such as will cut down opportunities of "invasion" to the minimum. Appropriate hygiene immediately before, during and after milking and the proper use of the right type of milking machine are means of reducing such opportunities for the mastitis organisms. I have shown that apparently quite trifling alterations in milking hygiene, such as the omission of disinfectant in udder washing water, even when using separate sterile udder cloths, and other rigorous methods of control, if persisted in long enough will result in substantial spread of *Str. agalactiae* in a herd (Hughes, 1953).

Murphy's stage of "inflammation" is that which most often concerns the clinician for it is responsible for the clinical manifestations of mastitis. But what are the factors

which allow " invasion " to proceed to " infection " and then to " inflammation."

Teat Patency.—At the " invasion " stage an external barrier such as the teat sphincter would be expected to be important. Ferguson (1944) found that mastitis frequently followed teat injury, a common enough clinical observation, but infections were predominantly with *Str. uberis* and *Str. dysgalactiae*. In our experience infections after injury, especially following Maclean's operation, are mixed in nature, and rarely include *Str. agalactiae*. Conversely Murphy (1945) found in a herd in which 90 per cent. of the infections were with *Str. agalactiae* that teat injuries occurred very infrequently. In our own observations in the Thurgarton herd extending over four years, there were no teat injuries although there were many cases of " infection " and a few of " inflammation " caused by *Str. agalactiae*. Teat patency does not appear to be of primary importance in preventing the entry of *Str. agalactiae* although it may be so with other mastitis pathogens.

Dose.—Many workers have experienced difficulty in setting up *Str. agalactiae* infections of the udder by artificial inoculation. Broadly speaking it may be said that single exposure to small numbers of this organism often failed to result in established infection, large numbers of organisms were more effective, but the most regular results followed repeated exposure to small numbers of *Str. agalactiae*, with as little incidental trauma to the udder as a result of the inoculating technique as possible. Ingenious methods have been described for this purpose by Jones & Little (1934) and Murphy (1953).

There is also some evidence that hypersensitivity may play a part in the pathology of streptococcal mastitis. Spencer & Angevine (1950) were able to elicit larger local reactions in infected cows than normal cows to the intradermal inoculation of antigen from formalinised *Str. agalactiae* cultures. The introduction of killed *Str. agalactiae* into the quarters of mammary glands freed of infection by treatment resulted in a hypersensitive reaction within a few hours. Similar reactions followed the injection of Group B streptococcal polysaccharide.

The effect of repeated exposure may be merely that it allows opportunities for the creation of a hypersensitive state. However, in practice it is probable that repeated and/or heavy exposure to *Str. agalactiae* is necessary before the occurrence of clinically obvious changes. In our experiments at Thurgarton it was found that providing deliberate opportunities for the spread of *Str. agalactiae* was not necessarily followed by immediate rapid spread. However, when spread took place this organism was widely distributed amongst the herd for some weeks before our first case of mastitis occurred. Incidentally, the rapidity of spread was governed by the particular kind of hygienic malpractice in operation at the time.

The genesis of mastitis, however, is not only a function of the duration of exposure and the number of infecting organisms; obviously the status of the cow must be of great importance. One must confess that our knowledge of the factors which influence the status of the cow is fragmentary. We have some evidence that the normal bactericidal property of milk plays a part; McEwen & White (1950) showed that this may vary throughout the lactation and it does not seem to be related to diet. There have been recurrent expressions of opinion, usually by agriculturists without bacteriological training, that nutrition plays a part in the production of mastitis. We need some well-designed experiments by nutritionists and bacteriologists working together to look at this aspect.

There is one factor of the host parasite relationship on which we have some evidence and that is the *age of the cow*.

There are many figures in the literature showing that the incidence of mastitis increases with lactation age. There are a number of obvious explanations for this, such as duration of exposure, but it would seem that the matter is not so easily explained. Murphy (1945, 1947) in a series of papers has propounded the view that the " age factor " *per se* operates for streptococcal infections, it being a function of age itself rather than increasing risks of exposure to streptococcal infection following prolonged stay in infected environments. He found that this age factor did not operate with staphylococci. This interpretation has been contested by Ormsbee & Schalm (1949). However, Lancaster & Stuart (1949) at Weybridge, in a number of well-designed experiments showed that age in itself was of importance. They exposed three groups of cows to *Str. agalactiae* infection by hand milking them with hands dipped in *Str. agalactiae* infected milk. There were three age groups: first calving heifers, second calvers, and older cows. The animals in the first two groups had not been infected previously with *Str. agalactiae*, but five out of six of the older cows had been treated and cured of this infection prior to the experiment. All the cows were equally exposed to heavy infection twice a day. The oldest cows became infected first and the heifers last, the following figures giving the total infections in each group: heifers 2/7, second calvers 4/5, older cows 6/6. These infected cows were treated and their infections sterilised, then they were re-exposed to infection by direct intra teat infusion of secretion from a case of *Str. agalactiae* mastitis, Stuart & Lancaster (1949). It was found that the quarters most susceptible to infection by hand milking were also correspondingly susceptible to infection by infusion. These experiments have not received the attention they deserve, for to me they lend impressive weight to the age factor theory and also show that it is not related to teat patency.

We also have found an interesting relationship between age and certain mastitis infections in the data from our survey of clinical mastitis.

It will be seen from Table II that the *Str. agalactiae* infections reach a peak of 28·0 per cent. in the age group five to six years, whereas *Staph. pyogenes* reaches a level of 17·5 per cent. at two to three years and maintains roughly the same level until six to seven years. Of course there is an obvious fallacy in the declines in the older groups in that there will be fewer cows at risk, but this operates for both organisms, so it seems clear from these figures that *Str. agalactiae* becomes more of a risk as cows age, whereas *Staph. pyogenes* is a continuing risk from the time of first calving. I do not think we can ignore the fact that age in itself is a factor in the genesis of mastitis caused by certain organisms, but not in that caused by others.

Treatment

The enormous scientific literature on the subject of mastitis is mainly provided by articles on the subject of diagnosis and treatment. The concentration on these two aspects is a material reflection of the difficulties in the field. I think it is true to say that even the most experienced clinician would be hesitant about attaching a bacteriological label to each case of mastitis purely on its clinical symptoms, although some of the more spectacular types associated with *C. pyogenes* and the acute gangrenous mastitis

Table II
Distribution of Infections in Age Groups, 1949–52

	Age in years	<2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	9–10	>10	Total
	Numbers	0	18	33	82	111	77	46	14	9	7	397
Str. agalactiae	Per cent.	0	4·5	8·3	20·6	28·0	19·4	11·6	3·5	2·2	1·7	99·8
	Numbers	0	35	36	33	36	31	12	8	6	3	200
Staph. pyogenes	Per cent.	0	17·5	18·0	16·5	18·0	15·5	6·0	4·0	3·0	1·5	100·0

caused by *Staph. pyogenes* may be exceptions. As a result there has been a great deal of effort devoted to devising a simple cow side test to aid the clinician. Despite these efforts we still have to rely on bacteriological cultures for a firm identification of the causal organism. There are certain technical short cuts, as the screw cap pots containing medium on to which the milk is drawn directly, and the Hotis test, but these have their limitations if a full bacteriological picture is desired. Nevertheless the laboratory facilities available to veterinary surgeons for mastitis diagnosis are greatly improving and extending, largely due to the efforts of the Veterinary Investigation Service, and there can be few veterinary surgeons who cannot call on the services of a laboratory to help them investigate a problem herd.

The other major interest in the mastitis literature has been, and continues to be, treatment. Many of you on casting your minds back will remember treatments as crude as formalin by the mouth; the acridine dyes by infusion came next, to be followed by sulphonilamide by the mouth. The application of some chemotherapeutic agents such as acridine dyes and more particularly the sulphonamides by the mouth, may be said to be our first steps in the logical chemotherapy of infections of the bovine udder. There followed a series of studies on agents such as colloidal silver (Novoxil) and the first antibiotics to be used in mastitis therapy, namely gramicidin and tyrothricin. Considerable effort was put into this early work, and much of it in this country was done by S. J. Edwards, of Compton, a worker whose continuing contributions to our knowledge of mastitis invokes our admiration. However, many of these compounds are now of purely historic interest, and modern treatment started with the use of penicillin. I think it needs emphasising that penicillin still remains the best single treatment of mastitis, using the word mastitis in its general sense. The majority of the cases met with to-day in most veterinary practices are still likely to respond to this antibiotic. Even with such an intractable condition as " summer mastitis " there is the odd cow infected with *Str. dysgalactiae* which will respond to penicillin. We must not forget that " summer mastitis " is a purely clinical term and that there is a danger in constantly equating it with *C. pyogenes*. Stuart, Buntain & Langridge (1951) have clearly shown that the bacteriological picture of " summer mastitis " is mixed and complex, and that more than the presence of *C. pyogenes* is probably necessary to initiate infection.

There is, of course, no question that the most outstanding successes with penicillin are obtained with *Str. agalactiae* infections, especially if applied on a herd basis, all cows being treated at the same time. Whether the whole herd should be treated, or merely the infected cows, is best decided after ascertaining the level of infection in the herd as a whole. Probably anything over 50 per cent. infection rate justifies treatment of every cow. This should be accompanied by treatment of teats and the milkers' hands. In our experience no special elaborate disinfection of premises at the same time is necessary. This so called " blitz approach " is successful because the reservoirs of *Str. agalactiae* which are in or on the bovine udder can be sterilised at one time. One would not expect such herd treatments to be quite so successful for the staphylococci or *Str. uberis*, whose distribution within the cows is different; but on the other hand these " blitz methods " have not really been tried in these infections and it may well be that they could be more successful than we expect.

Despite very definite advances in treatment many veterinary surgeons state that they meet infections with some frequency, in the opinion of some with increasing frequency, which will not respond to penicillin treatment. One must emphasise that these resistant infections are most unlikely to be due to resistant strains of *Str. agalactiae*. Miss Aynsley (1953) in our laboratories has found that in 500 cultures of bacteria freshly isolated from cases of bovine mastitis no resistant organisms occurred. This included 126 strains of *Str. agalactiae* and 116 strains of *Staph. pyogenes*. It may be that we shall eventually run into resistant strains of *Staph. pyogenes*, but as yet such evidence has not been published in this country. In our opinion the resistance of cases of mastitis to penicillin treatment must be sought within the cow rather than within the organism. Penicillin and some of the newer antibiotics such as aureomycin, chloramphenicol and terramycin, are all active agents on the laboratory bench, and their effectiveness within the udder will be partly governed by the extent and character of pathological changes within the gland. Many treatment failures are probably explicable by the therapeutic agent failing to reach the site of some of the organisms. The pathological studies undertaken by the A.R.C. workers at Compton have shown that the changes which take place within the udder following experimental inoculation in the goat may easily end up with irreversible changes which no treatment could rectify. Our efforts in treatment research might be better directed towards new ways of presenting established antibiotics rather than feverish searches for some antibiotic as yet undiscovered which it is hoped will cure all cases.

The American mastitis picture has been greatly complicated by the indiscriminate and unthinking use of the existing antibiotics, largely because such treatments have been made freely available to farmers. Probably as a result of this injudicious use of modern treatments many areas in the U.S.A. now have formidable problems associated with, to us, relatively unusual organisms like *Pseudomonas*, coliforms and yeasts. These infections are extremely difficult to handle and we would do well to reflect on how these problems arose. It is not enough to say that these drugs should not be obtained on free sale by farmers if in fact we as a profession are content to dispense them widely to clients for use without adequate supervision. I am afraid

that in some practices this has already happened, and farmers are able to obtain penicillin from their veterinary surgeon in such amounts that no adequate supervision of its use is possible. I do not suggest that present-day conditions in practice allow veterinary surgeons to see every individual case of mastitis, but there is a definite responsibility on the part of the veterinary surgeon for some herd supervision of the use of penicillin or any other antibiotic which may become available in the near future.

No advances in our knowledge of control or treatment of mastitis are ever going to simplify the prevention and treatment of this collection of infections to the point when the farmer and cowman will be competent to deal with them without veterinary assistance. Let us not forget that the mastites are bacteriological infections causing pathological alterations in the udder of the cow, and that for their adequate solution only a person with training in bacteriology, pathology, hygiene and animal management is competent to give the overall directions and control necessary. Such a person can only be the veterinary surgeon.

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Discussion

The discussion was opened by Mr. P. R. Blair Fish, who congratulated Mr. Hughes on his interesting paper and expressed the hope that it would stimulate a lively discussion.

He expressed his admiration for the survey of mastitis carried out in conjunction with Mr. E. Wilkinson. The figures quoted showed, however, that in 1953 only half as many samples were taken as in 1949. Did this indicate that more cows were being treated by the farmers without prior sampling? In his own practice this was increasingly the case. To-day penicillin was frequently dispensed to clients. He regretted that this was necessary. Only by the veterinary surgeon seeing every case of disease in his area could an accurate survey of disease be made.

Particularly striking was the importance of repeated small doses of *Str. agalactiae* infection, and of hypersensitivity in cured quarters. These dangers made it essential to eradicate *Str. agalactiae* infection, whenever possible, from self-contained herds. Was it possible to keep a herd free from infection after a "Penicillin Blitz"?

With regard to cases of mastitis which did not respond to penicillin therapy, there were three possible reasons. (1) Fibrosis of the udder, especially the small ducts leading from the secretory acini to the teat system. (2) Production of penicillinase by the animal body. (3) Replacement of sensitive organisms by others which were resistant to penicillin.

Mr. Hughes had stated that unusual types of infection in the U.S.A. might be attributed to the indiscriminate use of antibiotics. Why was this so? In this country cases had been recorded of infection with *B. coli* and yeasts introduced from the skin of the teat by the intramammary tube. Imperfectly sterilised vehicles for the antibiotic had been blamed for acid-fast bacillus infection of the udder. Could *Staph. pyogenes* be called a "normal flora" of the udder?

In this country there were already a wide variety of treatments for mastitis, but no treatment seemed able to cure a dry udder infected with *C. pyogenes*.

Finally, would Mr. Hughes advise on whether an acutely inflamed udder should be massaged, fomented and stripped at frequent intervals, or given complete rest.

Mr. Balls raised the question of culling the dangerous animals, from the standpoint of mastitis, and how this clashed with the need for keeping these animals if valuable for breeding purposes. This could lead to breeding from animals susceptible to mastitis. He found that a large number of cases did not respond to penicillin. Aureomycin had succeeded in some of these. Would Mr. Hughes comment on the rôle of flies in the spread of summer mastitis?

Mr. Clarke asked about the use of medicated bougies, suggesting that they might be an improvement on the tube method, and also asked if the acid-fast organisms found in udders had any effect on the tuberculin test.

Mr. Gray mentioned the use of *Staph. toxoid* in the treatment of mastitis, stating that he had found it very successful, although recently it had received little comment.

Mr. Pasfield wished to know if hypochlorites were the best agents for adding to the water for washing the udders.

Mr. Willett instanced cases where the milk suddenly ceased but samples proved negative bacteriologically.

Mr. Chipperfield spoke of the clinical cases where samples were found negative on bacteriological examination. He contrasted the modern housing of cattle with the old-fashioned methods, and suggested that the cows lay much less comfortably in the modern sheds and that perhaps this was another factor in the incidence of disease.

Mr. Peace desired information on the size and frequency of dosage of penicillin and also as to what action one should take in cases where *Str. uberis* and *Str. dysgalactiae* were found in the milk but the animal showed no clinical symptoms. He stated his belief in the usefulness of massage and fomentation of the udder as it enabled a greater amount of debris to be removed.

Mr. Scott Dunn deprecated the use of bougies as they readily carried infection into the teat. He recalled that Lord Nuffield deserved tribute for his part in furthering the production of penicillin.

Miss Uvarov mentioned a publication in which mastitis was listed as the disease third in importance in cattle. The true incidence of diseases should be determined by all means in our power. Great care should be taken not to rush to conclusions about the various antibiotics. New ones would not prove a panacea but they would demand a greater degree of skill in diagnosis. The clinician would still have to discriminate, and she would suggest the use of the simpler antibiotics, reserving the newer ones as a second line of attack. The parenteral application of antibiotics was raised and Mr. Hughes's opinion asked on this point. The

information on antibiotics in American literature was valuable. Even if the authors tended to rush into print, they provided information not otherwise available. Referring to massage of the udder, she considered that the old adage, "inflammation demands rest," applied. The intravenous injection of oxytocin seemed promising in treatment. It produced relaxation with a complete let-down of debris, after removal of which antibiotics could be used. Miss Uvarov also mentioned Pearson's work on summer mastitis.

Reply by Mr. Hughes

In the course of his reply to the various questions raised, Mr. Hughes said that Mr. Wilkinson had found the inevitable dispensing of penicillin tubes to clients was rendering the survey of mastitis less comprehensive. However, any data which could be collected on the incidence of disease, even if imperfect, was better than none.

Self-contained herds freed from *Str. agalactiae* infection should remain free without continuing with elaborate hygienic methods, provided only maiden heifers joined the herd and that precautions were taken to treat the hands of any new milkers with penicillin ointment for five days.

Mastitis infection which resisted treatment might be one in which fibrous tissue formed a wall between organisms and antibiotic. A supposed cure might be due to encapsulation of the infection.

Organisms capable of setting up an infection in the udder had been isolated from the antibiotic vehicle in tubes for intramammary therapy, but this was extremely unlikely to happen with material prepared by most firms in this country, as elaborate precautions were taken.

A normal bacterial flora of the udder had never been established. If it did exist it would be in the teat but not higher up.

Inflammation of the udder should be treated on general surgical lines. Removal of exudates would be beneficial, but if massage and stripping were employed for this purpose they should not be carried out too vigorously.

The decision on removing valuable breeding animals from the herd was one to be taken by the owner himself, after having the full facts placed squarely before him.

Str. uberis was important as exemplified by 18 per cent. of mastitis cases in his own area being due to this cause. It seems to be commoner in the winter months, and when a graph of the incidence is plotted to a base of months, the curve suggests that the incidence might be related to the housing of the stock. *C. pyogenes* is common in some areas but not in others.

Bougies can be manufactured and perhaps packed in a sterilised state, but the unpacking and handling at time of use could scarcely be aseptic. The tube method was much better in this respect.

Staph. toxoid was no doubt beneficial in some cases. The sparse mention given to it recently might indicate that its use had gone out of fashion.

Hypochlorite might not be the ideal agent for adding to the udder washing water, but it was the best available and certainly superior to the detergents which de-fatted the skin and led to chapping of the teats.

Supposedly sterile samples of milk from obvious clinical cases of mastitis were a worry to the laboratory worker. At Thurgarton he had examined some of these samples with special care, submitting them to techniques which would neutralise the effect of penicillin that might be in the milk, and including biological examination of the samples. It could not be said that these rather more elaborate examinations had thrown any further light on the reasons for the absence of organisms in the samples.

The following hypothetical reasons for such samples came to mind:—

1. Some form of treatment prior to sampling, such as sulphonamide dosing or penicillin infusion, which could be done by the farmer without him declaring it to the veterinary surgeon.

2. The pathological changes in the udder and milk might be the end result of an infection, the causal organisms having been destroyed leaving only inflammatory debris.

3. Mild disturbances of the udder due to non-specific causes unassociated with organisms. Varying degrees of trauma would come into this category.

The interpretation of the significance of a bacteriological report must always be the responsibility of the clinician. Even speaking as a bacteriologist he had found that the presence of a pathogenic organism in a herd in the absence of clinical disturbances should not always be taken too seriously, provided it was realised that cows so infected could easily become clinical problems if there was any change in method or even a change in the milker. On the question of dosage of penicillin he would suggest that this should be considered in terms of the organisms which it was proposed to destroy. Perfectly satisfactory results could be obtained with 25,000 to 50,000 units once a day for four days for the treatment of *Str. agalactiae* infections, whilst on the other hand a more blunderbuss dosage was preferable to deal with other infections as well, and in his opinion 100,000 units was the best dose for cases in general, to be applied for three, four or even five days. Nevertheless, the most satisfactory use of penicillin would always have to be related to the particular infection in question, and the history of the herd concerned.

The newer broad spectrum antibiotics were capable of dealing with a wide variety of organisms, but in this country the organisms involved in mastitis were still chiefly of the gram-positive type, all more or less susceptible to penicillin. It followed that increasing the range of an antibiotic would not necessarily increase its efficiency for the particular problem. The parenteral use of antibiotics was not advocated. In the case of penicillin very large doses were necessary (3½ to 5 mega units) and even then the level achieved in the milk was low. Theoretically the use of oxytocin appeared to be sound in releasing dammed-up inflammatory debris; its use as an adjunct to treatment should certainly be tried. Miss Uvarov had mentioned Pearson's work in Northern Ireland using penicillin as a prophylactic injection against *C. pyogenes* infections. In his opinion this was a very valuable piece of work and it was to be regretted that there was no evidence from this side of the Irish Sea which had been published to confirm or refute his results.

VIRUS HEPATITIS ORDER, 1954

As the result of an outbreak of virus hepatitis among ducklings on a Norfolk farm, the Minister of Agriculture has made the Virus Hepatitis Order, 1954, which brings this disease among those scheduled by the Diseases of Animals Act, 1950. The disease had been known in America since 1950 but no previous outbreak had been notified in this country.

Symptoms develop rapidly, and mortality, which varies greatly and may be as high as 90 per cent. or more in extreme cases, occurs within two or three days. Affected birds must be detained and isolated and premises and utensils cleaned and disinfected under the 1950 Act. Birds may be slaughtered if this is considered to be necessary, and compensation is paid in the usual way.

THE NORMAL INTESTINAL FLORA OF THE PIG. I.—BACTERIOLOGICAL METHODS FOR QUANTITATIVE STUDIES

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There are few publications dealing with the normal intestinal flora of the pig. Pfeiler (1929), in his review of the intestinal flora of domestic animals, referred to early work by Heinick (1903) and, more recently, Bauer & Englert (1952) have discussed Heinick's findings in their review on piglet diarrhoea. Heinick examined 23 healthy pigs, and in his studies of the small intestine, caecum and rectum regularly found *Bacterium coli* and *Bact. lactis aerogenes*, together with staphylococci. Pfeiler also reported that the rectum of the pig contained large numbers of *Proteus* and "subtilis-like" organisms. Moukhine (1936) claimed that *Lactobacillus acidophilus* was of value in preventing diarrhoea in pigs; *in vitro* experiments supported this *in vivo* observation, and indicated that most intestinal lactobacilli isolated from healthy pigs could inhibit the growth of enteric and paratyphoid organisms cultured with them. Komarev (1940) traced the development of the intestinal flora in suckling pigs for 50 days from birth; he isolated *Bact. coli*, *L. acidophilus*, streptococci and anaerobic sporeformers consistently, and spirochaetes occasionally. These observations suggest that there is no specific "milk flora" in suckling pigs. During the course of recent work on the feeding of antibiotics to pigs Bridges, Dyer & Powers (1953) studied the faecal flora of the control pigs. Since they used differential media for the isolation of *Bact. coli*, *Proteus*, staphylococci, *Salmonellae* and *Shigellae*, their claim that these organisms are the chief components of the normal flora must be treated with reserve. Quin, Story, Catron, Jenson & Whalen (1953a) also studied the normal intestinal flora, and found large numbers of lactobacilli and streptococci, together with *Bact. coli*. However, in a subsequent paper, Quin, Lane, Ashton, Maddock & Catron (1953b) write, "It seems obvious that there is no normal flora of the swine intestinal tract, but rather the numbers and types of micro-organisms found in faeces are largely a reflection of the quality and quantity of the ration consumed." The concept of potentially pathogenic organisms existing saprophytically in apparently healthy animals is not new, and numerous papers have appeared recently on the occurrence of *Salmonellae* in the intestines of normal pigs (Conti & Sarti, 1941; Huisman, 1952; Smith & Buxton, 1951, and Varela & Olarte, 1952). These authors gave tentative figures of the proportion of carriers in pig populations of various parts of the world, but the numbers of *Salmonellae* in the intestines and faeces of carrier pigs are not known.

The work outlined here represents a first step in collaborative studies of the intestinal flora of the pig and factors affecting it. Observations of immediate interest are recorded pending publication of a detailed account of these investigations. Careful surveys, both of numbers and types of organisms, were clearly required to provide a reliable background for subsequent work. Numerical aspects have been studied first, since it was considered that the relative importance of different types of bacteria could only be appreciated when considered in relation to knowledge of the total viable flora and the factors influencing it. The factors responsible for variations in total viable numbers have been considered under three headings: laboratory methods for handling test material, the individual pig, and the management of the pig.

Early experiments were made with fattening pigs which were group-fed in a Danish-type piggery under conditions which did not permit careful control of the individual animal. In subsequent work the variations in environmental conditions were considerably reduced by the use of pigs housed in individual pens in a new experimental piggery. A group of three Large White litter-mates of similar weaning weights was used as an experimental unit. The pigs received a "standard" ration, consisting of 50 per cent. fine millers' offals, 20 per cent. barley meal, 20 per cent. flaked maize and 10 per cent. white fishmeal, which was fed as a wet mash according to live weight and a scale for fattening pigs (Braude & Mitchell, 1951). For each group of pigs, a sufficient quantity of the ration was mixed to last for the whole experimental period.

Faecal Material

Throughout the greater part of the work freshly voided faeces were used. Laboratory investigations were made chiefly by dilution counts in liquid media, and yielded information on the main types as well as on the numbers of viable organisms. The media used were MacConkey's broth (MacB) for coli-aerogenes counts, and reinforced clostridial medium (RCM) (Hirsch & Grinsted, 1954) and tomato dextrose broth (TDB) (Briggs, 1953) for general counts.

Faeces were examined firstly for intra-sample variations, and some degree of heterogeneity was apparent. Emulsification, either by manual or mechanical shaking, failed to reduce the variations sufficiently to justify routine emulsification of samples. However, it appeared from the subsequent results that the intra-sample variations that were encountered were of no significance. The possibility that delay in examining faeces might result in variations in count was also investigated. In some experiments, variations in counts resulted from delay in culturing, but in others only minor changes occurred even over periods as long as 48 hours, whether the samples were stored at refrigeration or room temperature. The reason for these differences is not yet known but in view of the fact that such variations may occur, it is important to handle samples as rapidly as possible.

The daily variations in the total counts of faeces from individuals were followed in a group of three pigs given the standard ration for four months. The data also provided information on variations between pigs receiving the same ration. The results showed that variations occurred both from day to day and from pig to pig. In RCM 95 per cent. of the counts were in the range 10^8 to 10^9 per g., the remaining 5 per cent. being above this range. In TDB 92·3 per cent. were in the range 10^8 to 10^9 per g. with 7·7 per cent. above. Over a longer period of time, and including a number of other pigs, the figures were slightly different. Namely, in RCM 80·5 per cent. of the counts were 10^8 to 10^9 per g., 18 per cent. were above and 1·5 per cent. below; in TDB 82 per cent. were 10^8 to 10^9 per g. with 16·5 per cent. above

* In receipt of an Agricultural Research Council Grant.

and 1·5 per cent. below. These figures show $1·0 \times 10^8$ to $9·9 \times 10^9$ per g. to be the range in which total counts from normal pigs generally fall. The counts in MacConkey's broth were less consistent ; 79·4 per cent. were in the range 10^7 to 10^8, 11·8 per cent. between 10^6 to 10^7 and 8·8 per cent. below 10^6 per g.

Caecal Material

With the co-operation of a local bacon factory, caecal contents were obtained from pigs immediately after slaughter, and returned on ice to the laboratory as rapidly as possible (15 to 30 minutes). The homogeneity of caecal material was examined before and after mechanical emulsification ; the variations in total counts were found to be small and of the same order as those in faeces. The influence of time lag was also determined. With intervals up to six hours the samples showed only small variation, and it was concluded that short delays would not produce significant changes. Comparisons of faecal and caecal samples from the same individual were made on a number of pigs. Although there was a tendency for faeces to give slightly higher counts than the corresponding caecal samples, it was considered that they gave a sufficiently close approximation to caecal values to justify their use as an index of caecal numbers. The physical consistencies of faecal and caecal material suggested that the slight discrepancies in count might be explained by differences in the dry matter contents. The average values for faecal and caecal samples were found to be 23·3 and 12·11 per cent. respectively. The ratio of faecal to caecal dry weights was therefore 1·9, and the use of this factor when recalculating caecal values gave close agreement between faecal and caecal counts (Table I).

Table I
Comparison of Faecal and Caecal Counts (Mean Values per G.)

Medium	Caecum	Caecum (corrected for dry/wt.)	Faeces
RCM	$4·77 \times 10^9$	$9·06 \times 10^9$	$1·28 \times 10^8$
TDB ...	$7·32 \times 10^8$	$1·39 \times 10^9$	$1·43 \times 10^9$
MacB ...	$4·2 \times 10^8$	$7·98 \times 10^8$	$7·31 \times 10^8$

The influence of changes in diet on the numbers of viable organisms in the faeces of groups of three pigs was studied in two consecutive experiments. Following a control period of three weeks after weaning, in which the three pigs received the standard ration, the effects of (*a*) replacing a proportion of the cereals with grass meal and (*b*) replacing all the fish-meal with a vegetable protein (ground nut cake) were investigated, one pig continuing on the standard ration as a control. Close agreement between the results of the two experiments was obtained ; no marked numerical changes were observed, all counts remaining within the normal range previously defined (Table II).

The results of these experiments question the contention of Quin *et al.* (1953b) that the quantity and quality of the ration influence the number of organisms in the intestinal flora of the normal pig : this may well be true, however, so far as bacterial types are concerned. Microscopic examination and cultures of positive high dilution tubes showed that most of the organisms present in pig faeces are lactobacilli and streptococci ; coli-aerogenes types are present in lower concentration as indicated by the MacConkey's broth counts; these results agree with those of Quin *et al.* (1953a). Small numbers of micrococci, bacilli, *Pseudomonas* and moulds were observed by direct plating of low dilutions.

These observations provide a basis for future studies of the nature, numbers and significance of the individual types of bacteria in the intestinal flora of the pig.

Acknowledgments.—We wish to thank Dr. A. T. R. Mattick and Dr. L. F. L. Clegg for their advice, and the staff of Messrs. Venners' bacon factory for their willing co-operation in supplying samples.

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Table II
Influence of Diet on Faecal Counts (Mean Values per G.)

Experiment I	Pig A		Pig B		Pig C	
	Standard ration	Ration with grass meal	Standard ration	Ration with vegetable protein	Standard ration	Standard ration
RCM	$1·32 \times 10^9$	$9·61 \times 10^8$	$8·0 \times 10^8$	$6·77 \times 10^8$	$1·09 \times 10^9$	$5·92 \times 10^8$
TDB	$1·59 \times 10^9$	$1·66 \times 10^9$	$1·45 \times 10^9$	$8·34 \times 10^8$	$9·39 \times 10^8$	$7·55 \times 10^8$
MacB	$1·03 \times 10^8$	$4·04 \times 10^8$	$9·75 \times 10^7$	$1·81 \times 10^8$	$3·96 \times 10^7$	$3·96 \times 10^7$

Experiment II	Pig D		Pig E		Pig F	
	Standard ration	Ration with grass meal	Standard ration	Ration with vegetable protein	Standard ration	Standard ration
RCM	$1·56 \times 10^9$	$8·21 \times 10^8$	$1·61 \times 10^9$	$1·18 \times 10^9$	$1·55 \times 10^9$	$1·34 \times 10^9$
TDB	$1·73 \times 10^9$	$9·35 \times 10^8$	$2·34 \times 10^9$	$1·01 \times 10^9$	$1·95 \times 10^9$	$1·83 \times 10^9$
MacB	$1·27 \times 10^8$	$2·96 \times 10^7$	$4·96 \times 10^7$	$4·71 \times 10^7$	$1·47 \times 10^8$	$1·7 \times 10^7$

CLINICAL COMMUNICATION

SEPARATION OF THE UTERUS IN A CAT

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Subject.—A small black and white house cat, three years old.

Previous History.—The patient gave birth, when she was nine months old, to a litter of three kittens, all still-born. Two of these were normally formed, the other malformed. This history was obtained from the owner, who was unable, however, to say whether or not oestrus was ever apparent subsequently.

In October, 1953, the owner noticed a marked increase in abdominal size. This disappeared without event.

Immediate History.—The cat was presented for examination in January, 1954, with symptoms of enormous abdominal distension, emaciation, inappetence and occasional retching. These symptoms had started about two weeks previously.

Examination.—At examination the body temperature was normal, respirations were shallow and laboured, and there were symptoms of dehydration and toxaemia. No vaginal discharge or mammary development was seen. The degree of abdominal distension was maximal and disallowed palpation.

Diagnosis.—A diagnosis of ascites of unknown cause was made and, of necessity, an extremely grave prognosis. Only in view of the apparent reversability of the condition, as exhibited four months previously, was it decided that an exploratory laparotomy was justifiable.

Operation.—Under ether anaesthesia a mid-line incision was made. A small amount of clear abdominal fluid escaped. An enormously enlarged uterus whose serosa was splitting here and there over most of its surface was the only visible organ, and the abdominal incision was extended to a maximum to allow its removal.

On attempting to withdraw the uterus it ruptured and about one pint of non-smelling, cocoa-coloured fluid was liberally deposited into and around the operation wound.

The collapsed uterus was extruded as far as possible. The ovarian pedicles were ligated in turn with silk, and preparation made to treat the cervical end similarly. It was then seen that there was no further connection between cat and uterus, the latter having in fact fallen out on to the table. The operation was finished in some haste, but a brief search failed to reveal the cervical end.

Post-operative.—With the aid of glucose-saline and penicillin, recovery was surprisingly uneventful.

The Uterus.—The two cornua and ovaries appeared normal apart from the pyometritic process. The specimen ended posteriorly as a symmetrical dome-shaped protuberance with a small shred of broad ligament (?) trailing freely behind. The posterior uterine arteries were, of course, not apparent.

Discussion

The cause of the uterine separation is difficult to visualise. Possibilities that come to mind include post-parturient uterine torsion, retention of a mummified foetus or a local ischaemia due to congenitally deficient blood supply. Whatever theory is held must not conflict with the fact that this uterus was once gravid and that unaided parturition occurred.

Unfortunately, no laboratory aid was sought.

ABSTRACTS

Applications of Animal Physiology to Agriculture*

In his presidential address to Section M of the British Association, Dr. Hammond shows the importance of applied physiology to the industry of animal production. Applied " animal physiology " is supplementary to other more academic aspects of physiology and is concerned with increasing body functions in order to increase the amount of animal products, such as meat or milk. Obviously applied animal physiology must draw heavily on the pure sciences of nutrition, endocrinology and genetics for basic information.

Dr. Hammond illustrates his theme from recent and current work undertaken to some extent by his own pupils and co-workers. He gives a number of examples of where laboratory studies, or pilot experiments in laboratory animals can now be applied to the large domesticated animals. Deep-freeze glycerinated semen can now be diluted and maintained for long periods without loss of fertility. As a result a semen " bank " can be set up until the genetic quality of the donor bulls has been established. The distribution of frozen semen can easily be introduced on a world-wide scale and such a distribution may be the answer to certain quarantine regulations.

The production of superovulation by adequate hormonal treatment has already been effected in the cow. The transplantation of ova to other cows has been performed but requires major surgical interference. Attempts to transfer ova by an inseminating pipette have failed so far, but should some such simple method prove to be possible, then it would be feasible to use poor cows as " incubators " for the more developed animal. If the ova can be fertilised and maintained for some time outside the body then improved strains could be widely distributed by air transport.

In milk production the application of new knowledge in endocrinology has produced interesting results. Not only can maiden heifers be induced to produce significant quantities of milk following oestrogen implantation, but good mammary development has been attained in steers. In this sphere the results of endocrine treatment and genetics will have to be developed further in order to produce the necessary early duct formation and elasticity of the mammary tissue to accommodate the extra milk formation.

The nutritional plane of dam and foetus plays an important part in applied physiology. The controlled nutrition of the dam has been shown to have a marked effect on its offspring, extra feeding during late pregnancy and early lactation being reflected in the early maturity of the young animals.

The application of knowledge concerning the heat-regulating mechanism has produced important results in applied animal physiology. This problem is one of the important factors in the process of acclimatisation of animals to tropical countries. In this country also it has important applications, for the premature or poorly developed young animal has an inferior tolerance to variations in environmental temperature. In lambs and young pigs this is one of the most important contributive causes of neo-natal deaths.

F. R. B.

* **Applications of Animal Physiology to Agriculture.** Hammond, J. (1953). *Advanc. Sci.* **38.** 237–241.

Direct Connections Between Hepatic Artery and Hepatic Veins in the Canine Liver*

On the results of physiological experiments it is suggested that the hepatic artery and portal vein do not pursue identical courses in the liver, but that hepatic arterial-hepatic venous connections exist. These connections, which allow a more rapid passage of at least a proportion of the arterial blood, are apparently closed by substances which produce arterial constriction.

R. N. S.

* **On Direct Connexions Between Hepatic Artery and Hepatic Veins in the Canine Liver.** Horner, W. H., *et al.* (1953). *J. Physiol.* **1.** 51–52.

* * * * *

Changes in the Lungs of the Newborn Lamb*

The observations were made on lambs delivered by caesarean section, the umbilical connection with the dam being carefully preserved. When the lambs were artificially ventilated with a gas a dramatic increase in pulmonary blood flow occurred, the increase being 3 to 10 times greater than the observed flow before ventilation. The flow change occurred quickly with the first few breaths and reached its peak in about a minute. Inflation with air, oxygen, or nitrogen was associated with an increase in flow but this was not the case when saline was used to expand the lungs. The increase in pulmonary blood flow is due to a reduction in pulmonary vascular resistance possibly due to a direct mechanical effect on the lung vessels when the lungs become filled with a gas. Although the pulmonary vascular resistance has not been observed in a normal new-born animal, the authors believe that spontaneous breathing will be accompanied by a fall in pulmonary arterial resistance similar to that observed in the experimental lambs.

The positive pressure required to inflate the foetal lung is relatively great, much greater than that required for the adult animal, but the resistance falls rapidly and continuously after birth.

In the foetus 29 to 80 per cent. of the blood in the aorta is derived from the pulmonary circulation being diverted via the ductus arteriosus. When the foetal lungs were distended artificially the flow of blood in the ductus arteriosus was reversed, *i.e.*, flowing from aorta to pulmonary artery. Occlusion of the umbilical cord facilitated this reversal of flow, no doubt due to an increase in the systemic peripheral resistance. The reversal of blood flow corroborates the suggestion that in the lamb there is no functional value at the aortic end of the ductus arteriosus.

The ductus arteriosus was not observed to close in any of the 23 lambs examined during the observation period of up to 1½ hours.

F. R. B.

* **Changes in the Lungs of the Newborn Lamb.** Dawes, G. S., *et al.* (1953). *J. Physiol.* **1.** 141–162.

THE BRITISH TURKEY FEDERATION

At a meeting of the British Turkey Federation in London, Dr. W. M. McKay, M.R.C.V.S., who is a member of the Foundation Committee, was elected to the Executive Committee.

REPORT

[Colony of North Borneo—Annual Report of the Department of Agriculture, 1951-52.]

Section XII of the report deals with livestock and veterinary matters. The policy and aims of the veterinary branch of the department, working in close collaboration with the agricultural staff, are laid down as being : the conservation and multiplication of all classes of domestic livestock to meet local needs for fresh meat, for ploughing, and for the small local export market.

To these ends measures are taken to prevent and eliminate animal diseases, to increase and improve local stock, and to make full use of their products. By quarantine measures a close guard is kept on the possible introduction of disease by animals and their products, and there is a strict control over outbreaks of indigenous diseases. There is a campaign to give advice to livestock owners, though shortage of qualified staff has seriously hampered this work.

The livestock population of the colony appears to have remained almost stationary since the last census in 1950. The general standard of animal husbandry is low. Apart from working animals there is no regular herding, and the cattle are semi-wild. Pig farming is also on free range, and goats and sheep are kept under similar conditions. Horses receive more attention and are often stabled. The idea of supplementary feeding is gaining ground.

Two Government-owned stallions imported from Australia in 1948 served approximately 30 mares in the 1952 season. The one surviving Siamese bull has been on loan to private owners and two importations of Middle White pigs have been distributed to various breeders.

Diseases of Livestock

Surra has been the primary disease of horses in North Borneo for the last 15 years, and during 1952 this disease received first consideration. Blood examinations are made at monthly intervals and treatment is given where necessary. Besides the curative treatment of infected cases with antrycide, protective injections of antrypol are given in infected areas.

During 1951, 3,850 blood samples were examined for surra, and in 1952 this number increased to 7,395. In 1952, 1,822 protective injections of antrypol were given. This injection is obligatory before ponies can be moved out of an infected area.

In the case of cattle the disease situation in the colony is much more favourable. No case of rinderpest, foot-and-mouth disease, or contagious pleuro-pneumonia was recorded during the period under review. Indeed, there are no records to indicate that these diseases have ever existed in the colony. No case of tuberculosis was reported in 1952 and the incidence of this disease is thought to be very low.

Occasional cases of anthrax and haemorrhagic septicaemia in buffaloes are believed to occur, although it has not been possible to obtain material for a definite diagnosis. Helminth parasites appear to be the main cause of ill health and unthriftiness in bovines.

The disease situation in goats, sheep and swine is particularly favourable.

Very great importance is attached to the freedom of the colony from rabies, and stringent precautions are taken against the introduction of this disease.

In poultry, Newcastle disease is still the cause of the greatest mortality. Preventive vaccination against this disease is very popular in the areas convenient for road and rail transport and where the inoculation of young immature birds can be carried out.

It is impossible to undertake any research work until the veterinary laboratory and research station has been built. Facilities exist for the general treatment of sick animals, and in 1952 over 1,500 animals received attention.

In this colony of primitive conditions and backward standards of animal husbandry, Mr. E. H. Holland, B.Sc., M.R.C.V.S., the one veterinary officer on the staff list, has a heavy responsibility. But in an area so blessedly free of the major stock diseases, there is a great opportunity to increase the productive value of the livestock industry with consequent benefits to local interests. W. W. H.

REVIEW

[**Beef Cattle Husbandry.** By Allan Fraser. Pp. 244. 54 illustrations. Crosby Lockwood. Price 18s.]

Cattle raising may be the world's largest industry and the production of beef the major part. It is perhaps not generally realised that the impact of the British housewife's choice, and of those who cater for her desires, has had an important effect upon the breeding policies of stockowners throughout the world since 1900. The ideal beef animal as to conformation, fat disposition, finishing and cutting values, has been evolved and fixed in the pedigree beef breeds here, and now overseas.

Ninety-eight per cent. of the dairy cattle of New Zealand have been radically changed between the wars to produce milk with higher butter fat values in order to supply this country with butter. The Canterbury lamb at 36 lb. dressed weight for the caterers in London has entailed a wonderful breeding programme.

In the early part of the second half of this year freedom of choice of meat is to be restored to the housewife. The use she will make of this freedom is going to make the next 10 years the most interesting in the history of scientific cattle breeding for beef production. Those who wish to take part in this enterprise in this country cannot fail to be benefited by, and instructed in, the science and art as portrayed in " Beef Cattle Husbandry." Here is to be found all the background which could be used as a stepping-off stone for the future.

Keeping a sharp look-out for present-day trends it appears that 40 per cent. of all beef produced in this country is going to be cow beef. Dairy cattle supply a big share of this 40 per cent. The dual purpose Shorthorn, and the Dairy Shorthorn, giving a modest 1,000 gallons with the required normal butter fat will be likely to have the smallest number of " bobby calves." When such cows are mated with a crossing beef bull, preferably hornless, and a calf marker, the resulting male calves born in March and hitherto unwanted should make good beef steers in the September two and a half years later.

The high yielding dairy cattle with a high percentage butter fat do not carry a good thigh ; and the progeny, even when the sire is a perfect beef animal, will not help the meat problem as witness the " bobby " calves in New Zealand.

The pure beef breeds will continue to produce the best carcases as to conformation, growth rate, marbling and finish, for cutting by the butcher at two years old.

Somewhere from overseas it will be necessary to import feeding stuffs. Lucerne and maize are the sheet anchors of the Americas, North and South. Dried Lucerne meal, and maize cut green, dehydrated and shipped to Britain may be the answer.

" Beef Cattle Husbandry " is most enjoyable reading, and cannot fail to have a ready response. There may be a reason for the illustrations not being in juxtaposition with the text, but for convenient reference it would be better if they were so.

QUESTIONS IN PARLIAMENT

Slaughterhouses

Brigadier Medlicott (April 8th) asked the Minister of Agriculture how much money has so far been provided by the Exchequer for the construction or alteration of slaughterhouses under the Livestock Industry Act, 1937.

Sir T. Dugdale. None.

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Livestock Marketing

Captain Duncan (April 14th) asked the Minister of Food whether he can now announce the details of the arrangements for marketing of livestock after decontrol in July.

Dr. Hill: Some information was given in the Appendix to the White Paper (Cmd. 9104) issued on March 19th. The consultations on the further details are almost, but not quite, complete. When they are there will be issued leaflets on cattle, sheep and pigs, giving the full details for the information of farmers and the trade.

Captain Duncan: Can my hon. Friend say when these details will be issued?

Dr. Hill: It is hoped to issue them in the first week of May.

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Pest Officers, Dorset

Mr. Crouch (April 15th) asked the Minister of Agriculture what salaries and travelling expenses were paid to pests officers in the County of Dorset; what salaries were paid to the operatives; and what has been the income of this department during the years 1952 and 1953.

Mr. Nugent: Salaries and travelling expenses paid to pests officers in Dorset amounted to £3,215 in 1952-53 and £2,866 in 1953-54. In these years wages paid to operatives amounted to £3,067 and £2,528. The income of the pests department in the two years was £6,738 and about £6,000.

Mr. Crouch: In the interests of economy and to make the pests department pay, will my hon. Friend consider reducing the number of pests officers to one? To have three pests officers to supervise eight rodent officers, or rat catchers, seems very much like overloading.

Mr. Nugent: My hon. Friend is not, perhaps, quite clear on the functions of the pests officers. They have an advisory function of advising farmers in Dorset generally about the destruction of pests, as well as overseeing the operatives. It may be that there is a large number of pests in Dorset, but, in any event, this number of officers is needed.

Mr. Awbery: Can the Parliamentary Secretary give an estimate of the value of the services rendered by these people and the advantages obtained from what they do?

Mr. Nugent: They are responsible for the destruction of pests generally—rabbits, mice, and so on—on farms and they perform a valuable function in preventing the destruction of a great deal of food.

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Myxomatosis (Statements)

Mr. Hurd (April 15th) asked the Minister of Agriculture if he will issue a weekly statement on the spread of myxomatosis among rabbits from now until the autumn.

Mr. Nugent: My right hon. Friend will certainly report from time to time on the spread of the disease into new areas. Weekly statements do not seem justified at present. If later the rate of spread of the disease increases, I shall be willing to consider it.

Mr. Hurd: Can my hon. Friend tell us the areas in which the disease has appeared to date and give an assurance that the Advisory Committee, which has produced such a good report, will continue to watch very closely the extent and character of the outbreaks and, in due course, make another public report, so that everybody may know the position?

Mr. Nugent: Yes, I can give my hon. Friend that assurance. The Myxomatosis Committee is a standing committee. It will continue to watch the development of the disease and my right hon. Friend and I will be able to give the House reports on how

it spreads in the course of the next month or two. There are now 17 established centres of infection, five of which have been confirmed in the past month.

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EXPERIMENTS ON ANIMALS (CANCER RESEARCH)

Mr. PETER FREEMAN (April 15th) asked the Secretary of State for the Home Department whether he will publish a table showing the number of experiments on animals for the purpose of cancer research in each year since these records were kept to the latest known date, and indicating the number of each variety of animal, separately; and the total over the whole period.

Sir D. MAXWELL FYFE: The annual totals of experiments on animals for cancer research since 1907, almost all of which were on mice, were as follows:

Year	*Total*	*Year*	*Total*
1907	45,032	1932	32,381
1908	40,870	1933	43,281
1909	45,182	1934	50,022
1910	49,662	1935	29,835
1911	41,025	1936	33,507
1912	24,870	1937	35,008
1913	26,269	1938	35,222
1914	22,371	1939	26,936
1915	11,657	1940	11,730
1916	7,624	1941	15,448
1917	6,231	1942	14,300
1918	6,027	1943	15,674
1919	7,644	1944	21,571
1920	6,136	1945	11,430
1921	7,359	1946	32,286
1922	13,146	1947	31,924
1923	14,081	1948	56,585
1924	8,083	1949	75,343
1925	12,623	1950	78,192
1926	15,167	1951	91,410
1927	15,275	1952	95,991
1928	34,180		
1929	20,098		1,367,820
1930	25,259		
1931	23,873		

NOTES AND NEWS

Diary of Events

Apr. 28th.—Meeting of the Lancashire Division, B.V.A., at the Midland Hotel, Manchester, 2.30 p.m.

Apr. 28th.—Ordinary General Meeting of the South Eastern Division, B.V.A., at the Royal Star Hotel, Maidstone, 6.30 p.m.

Apr. 30th.—General Meeting of the Mid-West Division, B.V.A., at the Berkeley Café, Clifton, Bristol, 2.30 p.m.

May 1st.—Annual General Meeting of the Association of State Veterinary Officers in the Auditorium of the Wellcome Research Institute, 183-193, Euston Road, London, N.W.1, 2 p.m.

May 5th.—Meeting of the Supplementary Veterinary Register Division, B.V.A., at 7, Mansfield Street, Portland Place, London, W.1, 2 p.m.

May 6th.—A symposium on "The Design of Animal Houses" at the Royal Society of Medicine, 1, Wimpole Street, London, W 1, 10.45 a.m.

May 7th.—Annual General Meeting of the Sussex Division, B.V.A., at the Old Ship Hotel, Brighton, 2.30 p.m.

May 12th.—Meeting of the R.A.V.C. Division, B.V.A., at the Canine Research Station, Newmarket, 11 a.m.

Sept. 19th—25th.—72nd Annual General Meeting and Congress of the British Veterinary Association at Torquay.

PERSONAL

Births.—CRIPPS.—On April 10th, 1954, at the Jarvis Maternity Home, Guildford, to Margaret, wife of J. H. H. Cripps, B.Sc., M.R.C.V.S., of 28, Stoke Road, Guildford, twin sons.

HARRISON.—On March 8th, 1954, at Matlock, to Eira, wife of Val Harrison, M.R.C.V.S., a son, Christopher David—a brother for Susan.

WATSON.—On April 12th, 1954, to Jean, wife of K. R. Watson, M.R.C.V.S., 1, Bird's Nest Cottages, Sid Road, Sidmouth, a daughter—April Jane.

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Marriage.—CRIGHTON—GILCHRIST.—At Burn Bank Church, Glasgow, on April 10th, 1954, George Wallace Crighton, M.R.C.V.S., eldest son of Mr. and Mrs. David R. Crighton, of 157, Starthmartine Road, Dundee, to Mary Gilchrist, M.R.C.V.S., the only daughter of Mr. James Gilchrist and the late Mrs. Gilchrist, of 376, Great Western Road, Glasgow. The Very Rev. W. Nethercote Scott officiated.

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R.C.V.S. OBITUARY

MELLARD, Reginald William, D.S.O. (Lieut.-Colonel R.A.V.C. retd.), Ireland's Cross, Woore, Nr. Crewe, Cheshire. Graduated London, December 16th, 1905. Died April 11th, 1954.

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UNIVERSITY OF LONDON

Pass List, March, 1954

B.Sc. (VETERINARY SCIENCE) EXAMINATION (FOR INTERNAL STUDENTS)

Malone, James Carruthers—Royal Veterinary College.

Wilkinson, John Sydney—Royal Veterinary College.

The following Student has passed in Part II only: Tucker, Jean Winifred—Royal Veterinary College.

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ROYAL SANITARY INSTITUTE CONGRESS

Two thousand two hundred delegates are expected to be present at the Health Congress organised by the Royal Sanitary Institute. The Congress takes place at Scarborough from April 27th to 30th.

The Earl of Feversham, who will be formally installed as President of the Congress by Dr. H. C. Maurice Williams, Chairman of the Institute's Council, will deliver an inaugural address. Included among the delegates will be representatives from nearly 40 countries, 20 British Government departments and approximately 1,000 local authorities. Over 50 addresses and papers will be given.

The section devoted to veterinary hygiene (April 30th) will comprise the following: Presidential address by Mr. Alexander Thomson, President of the B.V.A.; "Emergency Slaughter of Food Animals," by Mr. John Norval, M.R.C.V.S., Chief Meat Inspector, Edinburgh; "Brucellosis in Animals and Man: Its Cause, Nature and Prevention," by Dr. A. W. Stableforth, Director of Veterinary Research, Ministry of Agriculture, Veterinary Laboratory, Weybridge.

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SPANISH VETERINARY STUDENTS

Four Spanish veterinary students would like to come to England during July or August this year. They are at present attending the Veterinary University of Cordoba, and in exchange for hospitality they offer to do such work as may be asked of them. They would prefer to stay within reasonable distance of a University or Research Centre where they might meet other students or veterinary scientists, and in return for any invitation they may receive have undertaken to arrange a return visit to Cordoba for a like number of British veterinary students. Members of the profession who may consider offering hospitality to these young men are invited to write to one of them, Jaime Gomez, at Residencie Universitarie "Lucio Anneo Leneca," Calle Alfonso XIII No. 4, Cordoba, Spain.

The students are vouched for by the Association of World Friends, 308, Earl's Court Road, London, S.W.5.

EAST MIDLANDS DIVISION ANNUAL DINNER AND DANCE

The annual dinner and dance of the East Midlands Division was held on March 18th at the George Hotel, Nottingham. The guests included the President of the B.V.A., Mr. Alexander Thomson with Mrs. Thomson, Professor H. G. Robinson, Director of the School of Agriculture of Nottingham University, Mr. D. F. Oliver, President of the Lincolnshire and District Division of the B.V.A., and Presidents of the Nottinghamshire and Derbyshire sections of the National Farmers' Union. Mr. B. L. Hallward, Vice-Chancellor of Nottingham University, was unable to be present owing to indisposition.

Members and their guests were received by the President of the Division, Mr. W. H. Carr and Mrs. Carr, together with Mr. and Mrs. Thomson. A welcome to the guests was proposed by Dr. J. C. Buxton, and, in the absence of the Vice-Chancellor of the University, the response was made at short notice by Mr. D. F. Oliver. In proposing the toast "The East Midlands Division," Mr. Thomson said he thought that a good deal of the success of the B.V.A. was due to the fact that it was not over-organised. He reminded the company, amid laughter, that, although the B.V.A. itself was indeed the parent of Divisions, it was true, nevertheless, that some of the children had existed before the parent and appeared to be none the worse for it!

Mr. W. H. Carr, replying on behalf of the Division, thanked Mr. Thomson for proposing the toast and said that since he himself led a "cat and dog" life, he intended to speak on that aspect of veterinary work. He said he thought the profession and some members of the public were concerned as to whether money contributed to animal welfare societies was being used at all times to the best advantage. "Vast sums are collected each year for the treatment of animals of poor people," said Mr. Carr, "and I mean vast sums. I suggest that in such matters the public are ruled rather by their hearts than by their minds. They do not consider very carefully whether the money is used exactly as they would have wished or not." A committee which had been set up reeently to consider the licensing of unqualified persons in the treatment of sick animals of the poor had urged that animal welfare societies should consult together with a view to avoiding the overlapping of areas served by clinics. "Coming, as I do, from Leicester," said the President, "I am perturbed to find that, despite adequate arrangements for animals of the poor made in that city by the R.S.P.C.A., another welfare society proposes to step in and to overlap. I do appeal to the societies to pull together and consult together in the cause of animal welfare, instead of indulging in rivalry one with the other. May I assure them that this Division, and indeed this profession, will always give its wholehearted support to any organisation which aims to do its best for the animals of the poor."

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The President, Mr. W. H. Carr, greeting Professor H. G. Robinson at the East Midlands Division, B.V.A., annual dinner. On the President's left are Mrs. Carr and Mr. and Mrs. Alexander Thomson.

N.A.A.S. MEETING AT WARMINSTER—"DO GRASS SHEEP PAY?"

The panel of four which discussed the above problem before a large audience included a veterinarian, a Livestock Officer, the Principal of an agricultural institute and a well-known sheep farmer.

Reference was made to the changing picture relating to the keeping of sheep over the country as a whole and to the factors subscribing to the present low level in Wiltshire in particular. The steady decline in the number of shepherds was regarded with mixed feelings, some speakers expressing the view that they were not only no longer necessary but could be in fact a menace and a bar to progress, often being prejudiced against the introduction of any scientific methods and highly autocratic. The temporarily low numbers of sheep were not due to a lack of shepherds, not even to low mutton and wool prices, but to the greater attractions of dairy farming and to such factors as the high cost of suitable fencing. The panel felt that undoubtedly more sheep could be kept and many of the objections overcome by integrating them with the cattle. One sheep could be kept for every cattle-beast on the farm. Such a limitation would prevent the sheep from starving the cattle.

When discussing the management of sheep in more detail the value of a varied diet and the dangers of over-feeding were emphasised. Whilst general good condition was all-important, excessive condition would surely lead to trouble. The use of silage should be more widely practised and it was an advantage if flocks could always have a choice of pastures available. Gorging on a too-rich pasture for long could thus be controlled and the risk of pulpy kidney disease lessened. Concentration of sheep tended to lead to trouble which was directly proportional to the number of sheep kept.

The sheep farmer always sent his lambs forward through creeps, and favoured the use of mineral supplements containing phenothiazine. It was generally agreed that it was better to prevent disease than cure it and that sheep farmers should take more advantage of the discoveries of veterinary science.

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HUMAN AND ANIMAL HEALTH

Bristol may inaugurate a new venture in public health to investigate the connection between diseases in animals and in people.

A recommendation that a part-time veterinary officer should be appointed was made to the Health Committee yesterday by the Medical Officer of Health, Dr. R. H. Parry.

The recommendation was that the veterinary surgeon who had been acting on a part-time basis as the Committee's Inspector under the Diseases of Animals Acts, since 1948, should be appointed as a part-time officer on the staff of the Health Committee.

He would act as adviser to the Medical Officer of Health on matters affecting animal health and its relation to public health, and would undertake such investigations as might be necessary. In addition, he would act as consultant to the Chief Sanitary Inspector.

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ADDRESSES OF DISEASE-INFECTED PREMISES

The list given below indicates, first, the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

ANTHRAX:

Lanarks.—Over Tweedieside Farm, Sandford, Strathaven (Apr. 12).

FOWL PEST:

Ches.—Weatherstones, Neston, Wirral (Apr. 12).

SWINE FEVER:

Ches.—Bumpers Lane Farm, Bumpers Lane, Chester; Coach and Horses Inn, Dare-in-Shaw, Buglawton, Congleton (Apr. 14).

Derby.—72, Brownedge Road, Buxton (Apr. 12).

Lincs.—Ivy House Farm, Burgh Road, Skegness (Apr. 14).

Norfolk.—Frost Row Farm, Hingham, Norwich (Apr. 12).

Northants.—Malows Farm, Towcester (Apr. 14).

Stirling.—Polmaise Piggery, Fallin, Stirling (Apr. 14).

Sussex.—Burroughs Farm, West Chitlington, Pulborough (Apr. 13).

Yorks.—White House Farm, Ryhill, Wakefield (Apr. 12).

CORRESPONDENCE

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A.

APPOINTMENTS IN NEW ZEALAND

Sir,—I am interested to see that hardy annual, New Zealand Veterinary Club Vacancies, appearing in the advertisement columns to-day. Having spent the requisite 24 months in New Zealand, and having returned to England last October, I feel that my personal experiences may be of some help to those considering applying.

Too few appreciate that club practice implies control of the profession by lay persons. Not only control of the profession, but often very close control of the individual as well. To anyone advocating any form of State control of the profession in this country I can heartily recommend a two-year trial of the club system.

The salaries offered are of interest, but one must bear in mind that, although income tax is lower in New Zealand, social security tax is levied at 1s. 6d. in every £1 earned. In general the cost of living is higher in New Zealand than in England. For the majority the maximum salary will be £1,168 p.a., as there are very few better paid posts. There is no incentive whatsoever, as the salary is based on the number of years that one has been qualified. It bears no relationship to the quantity or quality of work undertaken.

Members contemplating taking cars to New Zealand should make enquiries concerning the relationship of the car allowance to costs. Last year the mileage allowance was 7d., which was adequate in parts of New Zealand where road conditions are good. In other parts one could suffer a financial setback by using one's own car. The roads on the whole are atrocious and, apart from petrol (3s. 6d. a gallon) and licensing, car expenses are heavy. The new car situation is acute, with very few American cars—which are those most suited to the road conditions. Car prices are the basic English price plus 66 per cent. import duty.

Members considering these posts would be well advised to contact friends in New Zealand before taking the plunge.—Yours faithfully, J. A. TOOVEY, Church House, St. Neots, Hunts. *April 10th*, 1954.

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CRYSTAL VIOLET VACCINE ON INFECTED PREMISES

Sir,—The Ministry of Agriculture do not recommend the use of crystal violet vaccine on infected premises, but I have used it under these conditions and with no regrets. Last year a client purchased some pigs at his local market and 14 days later purchased some more; about four days after the second purchase the pigs in the first group were ill and swine fever was diagnosed and confirmed. The farmer asked if I would inoculate the second group against swine fever and, as I had some crystal violet vaccine with me, I obliged. Those pigs did not have the disease and have now gone for bacon.

The old policy of sitting quietly and doing nothing, waiting for the pigs either to die or to get better, is obsolete. The farmers expect us to do something, and we are justified in trying to save as many animals as we can. Inoculation is our only remedy and I think it ought to be carried out. What is more annoying to a farmer than to tell him that nothing can be done, that he must make the best of it and watch his valuable pigs die?

If my policy is wrong, may we hear the other side of the question?

There must be many others who have used crystal violet vaccine on infected premises and I should be interested to hear their views on the matter so that we can get the Ministry's recommendation altered.—Yours faithfully, G. C. LANCASTER, Eastwick House, Evesham, Worcs. *April 4th*, 1954.